inches. Fish vary in size under different conditions and in different areas, and on the south-west coast the limit of size for maturity in plaice is 13 inches according to Mr. Cunningham. An immense number of the small plaice brought to market are caught on the eastern grounds; and this area forms also a nursery and spawning haven for turbot, brill and soles. The number of plaice above 10 inches on these grounds is inconsiderable; and if a size limit of 13 inches for plaice brought to market were enforced, even during the spring and summer only, such a limit would suffice to keep trawlers off these grounds, which would thus be left unmolested. In conclusion, Mr. Holt considers various remedial measures for checking the depletion of the North Sea grounds, and of enabling the fish supply to recover; but the only practicable method of attaining this end at present is by legislation based on the principle of the size limit.

THE FORMATION OF BACTERIAL COLONIES.[1]

THE author has examined the details of development of the colony from a single spore, in numerous species, by employing microscopic plate-cultures, which can be kept under observation under a one-twelfth and even a one-twentieth oil immersion, or by making pure *Klatschpräparate* of the growing colony on cover-slips covered with a thin film of gelatine.

He finds many factors of importance in affecting the form, extent, rapidity of growth, and other characters of colonies. The elasticity of the gelatine, the presence of moist films on the surface of the gelatine, the rate of (slight) liquefaction, &c., all being of importance, in explaining the shapes, &c., of submerged colonies—"whetstone shaped," moruloid, spherical, or lobed colonies—the mode of emergence and spreading over the surface of the gelatine, the formation of radiating fringes, iridescent plates, &c.

Exposure to light during the development of liquefying colonies may profoundly affect their shape and other properties, a phenomenon closely connected with the retardation of liquefaction and growth. Pigment bacteria may give rise to perfectly colourless races when cultivated under certain conditions, and the colour restored by again changing the conditions, a fact which the author has not only confirmed with red forms, but which he shows to be true of a violet bacillus. Species commonly described as non-motile show active movements under certain conditions, and the sizes of bacteria are not constant in different regions of one and the same colony. Details have been worked out for series of types, the extremes of which differ considerably in liquefying power, and essential difference in the appearance of a colony may depend on the amount of liquefying power evinced.

Some curious cases of travelling films, the lobes and contorted tresses of which move like amœbæ over the surface of the gelatine, were also examined.

The facts point to (1) differences in colonies even of one species may depend on much more subtle differences in cultures than are usually recognised; (2) varietal differences may occur in two bacilli of the same species (isolated from the river), due to the different vicissitudes the two individuals have been subjected to during their sojourn in the water; (3) the difficulties met with in diagnosing "species" of bacteria with the aid of works of known authority, are partly due to varieties of the same species being recorded by different observers under different names, and the author thinks some more consistent pre-arranged plan of working out the characters of such forms should be developed by bacteriologists than at present exists.

A FALSE BACTERIUM.

The author has isolated from the Thames a form which gives all the ordinary reactions of a bacterium in plate-cultures and tube-cultures in gelatine, agar, potato, broth, milk, &c.

It is a rod-like form, 1 μ thick, and up to 2 or 4 μ long, stains like a bacillus, and cannot be distinguished from a true Schizomycete by the methods in common use.

On cultivating it under high powers—one-twelfth and one-twentieth oil immersions—from the single cell, however, it is found to form small, shortly-branched mycelia, the growth and segmentation of which are acropetal. This turns out to be a minute oidial form of a true fungus.

Its true nature can only be ascertained by the isolation and culture through all stages from the single cell, according to the original methods of gelatine cultures of Klebs, Brefeld, and De Bary, which preceded and suggested the methods employed by bacteriologists; and the facts discovered raise interesting questions as to the character of alleged "branching" bacteria on the one hand, and the multiple derivation of the heterogeneous group of micro-organisms, termed bacteria in general, on the other.

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[1] Abstracts of two papers, read before Section K of the British Association t Ipswich by Prof. H. Marshall Ward, F.R.S.

UNIVERSITY AND EDUCATIONAL INTELLIGENCE.

CAMBRIDGE.—The following have been appointed Examiners in Natural Science for the current academical year:—Physics: Dr. O. J. Lodge, F.R.S., and Mr. L. R. Wilberforce. Elementary Physics: Mr. H. F. Newall and Mr. S. Skinner. Chemistry: R. Meldola, F.R.S., and Mr. W. J. Sell. Elementary Chemistry: Mr. F. H. Neville and Dr. S. Ruhemann. Mineralogy: Prof. N. Story-Maskelyne, F.R.S., and Mr. H. A. Miers. Geology: Prof. G. A. J. Cole and Mr. H. Woods. Botany: Dr. H. M. Ward, F.R.S., and Mr. H. Wager. Zoology: Prof. S. J. Hickson, F.R.S., and Mr. S. F. Harmer. Elementary Biology: Mr. A. C. Seward and Mr. J. J. Lister. Anatomy: Prof. A. Macalister, F.R.S., and Prof. A. M. Paterson. Physiology: Mr. W. B. Hardy and Prof. W. D. Halliburton, F.R.S. Pharmaceutical Chemistry: Mr. A. Ivatt and Mr. R. H. Adie.

Dr. Glaisher, F.R.S., and Mr. R. T. Glazebrook, F.R.S., of Trinity College, and Prof. G. B. Mathews and Mr. A. E. H. Love, F.R.S., of St. John's College, have been appointed Examiners for Part II. of the Mathematical Tripos; and Prof. Ewing, F.R.S., Prof. Reynolds, F.R.S., and Mr. J. B. Peace, of Emmanuel College, have been appointed Examiners for the Mechanical Sciences Tripos.

The twenty-second annual report on the local lectures has just been issued. It touches upon a number of interesting questions. Of the work temporarily undertaken for County Councils three years ago, the only portion that remains vigorous is that carried on in connection with the Norfolk County Council in the preparation of teachers in elementary schools to teach science subjects in evening classes. These courses, given in the county of Norfolk, have been supplemented by practical laboratory work in Cambridge during the Long Vacation, which has been attended by teachers holding scholarships from the Norfolk Council. The Syndicate state in the report that they are persuaded that this is a work of great value, and that they believe that it is in this direction, rather than by the provision of ordinary technical courses for rural audiences, that they can now best aid the technical education work of County Councils. During the past session the scheme of certificates has been remodelled so as to encourage more continuous and systematic work, and has already begun to show good results. The most important part of the report is that in which the Syndicate announce their intention to appeal for funds to enable the University to develop and extend the work in a more systematic way by placing particular districts in charge of superintendent lecturers, who will form a direct link between the district and the University. Appended to the report is a special report by Dr R. D. Roberts, the secretary for lectures, in which a large scheme for the future development of the work is sketched and practical proposals suggested.

A DIRECTORY of Science, Art, and Technical Colleges, Schools, and Teachers in the United Kingdom, by Mrs. R. S. Lineham, has been published by Messrs Chapman and Hall. The directory will undoubtedly prove of great value to all who are concerned with scientific and technical education. It contains a list of schools arranged alphabetically according to towns, with the names of secretaries, principals, and teachers, and the number of students taught in each subject. There is also an alphabetical list of names and addresses of teachers of science, art, and technology, arranged under the headings of subjects taught. Other information of particular use to teachers under the Science and Art Department, and needed now and then by all promoters of elementary scientific education, will be found in the volume. Complete the directory is

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not, nor is it infallible; but it is a praiseworthy attempt to organise into one guild the teachers of a growing and most important section of educational work. The labour involved in getting together the facts which make up the contents must have been immense, and it is to be hoped that, now the work has been done, the support required to ensure the annual publication of the directory will not be lacking. If the book only makes teachers in technical schools and institutes realise that they are part of one organic whole, having for its object the extension of scientific knowledge, it will accomplish a much-desired end.

THE Report of the Technical Educational Committee of the Berks County Council is optimistic, but it is not distinguished by descriptions of any very noteworthy developments. Berkshire is an agricultural county, and that is tantamount to saying that little encouragement is given to scientific education. Such counties are not willing to be taught much about principles; what they will tolerate, are subjects like practical butter-making, laundry-work, poultry-keeping, hedging, and horse-shoeing; but to attempt to teach agriculturists anything much beyond manual dexterity, is to court opposition. However, the Technical Education Committees are doing something to educate the agricultural mind to a better appreciation of the benefits to be derived from science, though it must be confessed that the rate of progress is extremely slow. Berkshire, along with Oxfordshire and Hampshire, contribute towards the maintenance of the University Extension College at Reading, and, in recognition of the satisfactory development of the agricultural department of the college, the Board of Agriculture recently granted a sum of £500, and the money could not have been better bestowed. The various courses of study at the college are well arranged, and valuable field experiments are carried on. By paying over the sum of £400 to the college, the Berkshire Committee ensures efficient instruction for the students under their care, and that is a very important consideration, for the supply of good teachers, competent to teach science as it should be taught, is comparatively small, to say nothing of the laboratory accommodation essential for truly scientific instruction. In spite of the facilities thus offered, the lectures in elementary science arranged for teachers were not successful. It would be a great pity if the Committee had to discontinue this part of their work on account of the want of support by the teacher for whom the lectures are intended. The other ways in which the Committee disposes of the funds allocated to technical education are evening continuation classes, scholarships, dairying, farriery, and bee-keeping. Aid is also given to classes in the principles of agriculture, mensuration, botany, drawing, horticulture, chemistry, mechanics as applied to agriculture, and to manual instruction in woodwork and metalwork.

THE Brussels correspondent of the *Times* reports that the electrical and anatomical institutes founded by M. Ernest Solvay, and presented by him and other donors to the University of Brussels, were officially inaugurated on Monday, under the presidency of the Burgomaster, assisted by M. Graux, the Chancellor, and the entire body of professors. Delegations from the English and Continental Universities have responded to the invitation of the Brussels University to take part in the series of *fêtes* organised in celebration of the event.

IT was announced a few weeks ago that the Treasury has thoughts of reinstating King's College, London, in the enjoyment of its share of the grants made to University Colleges. In consequence of this decision, the Council of the College have adopted a conscience clause as a standing regulation.

SOCIETIES AND ACADEMIES.

LONDON.

Physical Society, October 25.—Mr. Walter Baily, Vice-President, in the chair.—Prof. J. Perry read a paper, by himself and Mr. H. F. Hunt, on the development of arbitrary functions. During the discussion on Prof. Henrici's paper (April 13, 1894), one of the authors described a graphical method of developing any arbitrary function in a series of other normal forms than sines and cosines, such as Bessel's or zonal spherical harmonics. The method consisted in wrapping the curve which represents the function round a specially shaped cylinder, not circular, and projecting this curve on to a certain plane. Many months were wasted in finding with great exactness a sufficient number of coordinates of the trace of the cylinder suitable for a Zeroth Bessel development. The labour, however, was unnecessary, since the coordinate most troublesome to calculate is not really needed, the projection only taking place in one direction. To develop any arbitrary function of x (say y) in normal forms, the real difficulty consists in finding the value of an integral such as $\int_0^a y.\ Q(x).\ dx$ where $Q(x)$ is some tabulated function. If now z is another tabulated function which is the integral of $Q(x)$, the required integral is $\int ydz$. If the values for y for 25 equidistant values of x are known, from $x = 0$ to $x = a$. Let the corresponding values of z be tabulated, and let a curve be drawn with the values of y as ordinates and the values of z as abscissæ; the area between the axis of z and this curve gives the value of the integral required. The authors give four tables containing the abscissæ for the four first terms in the development in Zeroth Bessels. They have tested the method by applying it to the calculation of a known function in terms of zonal spherical harmonics, and the agreement between the true value of the coefficients and those found is very satisfactory. Prof. Henrici said the method was a new departure, since in the place of an instrument of complicated design the authors only used a planimeter and pencil and paper, and obtained the same degree of accuracy. The fact that the series employed to test the method consisted of a finite number of terms seemed to him an objection. Prof. Karl Pearson had in a recent conversation informed him of a method for the development of functions which he (Prof. Pearson) had recently discovered. This method was not, however, so simple—at least in most cases—as that of the authors. Prof. Minchin thought it would add to the intelligibility of the paper if it were stated that the method was similar to that employed when expanding in terms of a Fourier series or in spherical harmonics. In these cases you have a function which, when multiplied by other functions of different orders, kills all the terms except one. Graphic methods ought, in his opinion, to be very much oftener employed, and he considered that there was no problem in physical mathematics of which the solution could not be obtained by graphic methods. He would also like to know if Prof. Perry had obtained a graphic method of calculating Bessels. Mr. Trotter agreed with Prof. Minchin as to the neglect of graphic methods. He regretted that Prof. Perry did not continue to consider the method as the projection from a cylinder, as he had found the method of wrapping curves round a cylinder most useful. Prof. Perry in his reply said he had adopted the expansion they had employed, under the impression that the test was a particularly severe one. He had not discovered a graphic method of calculating Bessels. The reason they gave up the cylinder was the immense labour involved in calculating the y coordinates of the trace, which would afterwards be of no use in the development of the function.—Mr. F. W. Lanchester read a paper on the radial cursor, a new addition to the slide-rule. The ordinary form of slide-rule enables calculations to be made which involve multiplication and division, also involution and evolution where the indices are integers. The radial cursor allows of the solution of problems in which fractional indices occur; for example, in questions involving the adiabatic expansion of a gas, where an expression of the form $pv_\gamma = \text{const.}$ has to be dealt with, and where γ is not an integer, nor is it constant for all gases. In this case it is necessary to provide some ready means of dividing the scales on the rule and slider proportionally to the value of γ, which corresponds to the division and multiplication of the respective logarithms of the quantities dealt with in the proportion of the indices of p and v, *i.e.* 1 and γ. This proportionate division of the scales is effected in the new cursor by a radial index-arm which is arranged to swing about a stud fixed to a sliding-bar running in guides at right angles to the rule. All readings are taken at the points of intersection of a line on the radius arm and the edges of the slide. The distance of the pivot, on which the radius arm turns, from the scale, and therefore the value of the index employed, is read off on a scale fixed to the transverse bar. Mr. C. V. Boys said that owing to the kindness of the author he had been able to try the cursor, and had found it of great service in dealing with questions of adiabatic expansion. The new addition to the slide-rule suffers under the same disadvantage as the rule itself, namely that a verbal or written description seems so very much more complex than is the actual operation when using the rule. The author's device might be described as an india-rubber slide-rule, for it performed the function of a slide-rule in which the graduations

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